

Addressing Science Anxiety in German Fifth-Graders through Mindfulness

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Abstract: German primary school students' reading skills have declined between 2016 and 2021, with a deficit of up to one third of a school year. The most significant portion of the decline is attributed to the Covid-19 pandemic experiences. These delays are critical because children have to catch up on skills and knowledge they should already have while continuing to acquire new skills and knowledge. Students who are ill prepared in core readiness skills for secondary schools are simultaneously having to cope with the stressful experiences of school transition. Anxiety generally impedes participation in science classes, but the specific concept of science anxiety is less explored. Mindfulness has been successfully implemented in schools to alleviate stress as well as being somewhat effective in positively supporting student anxiety. This paper presents background to a current study that aims to address the significance of the issue of science anxiety amongst German post-transition students, and whether science anxiety can be improved through the implementation of a mindfulness program.

Keywords: Science anxiety, School transition, Mindfulness

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Introduction

Since early 2020, the Covid-19 pandemic has been interfering with global life in all its facets. Although the severity of the situation has since calmed somewhat, its aftereffects can still be noted. It is the younger generations in particular that have felt a significant impact as the pandemic has formed a large proportion of their current lifespans. In addition, we are now seeing the implications for children, as evident through various recent research publications. In Germany, the large-scale COPSy study has been central to demonstrating this. Evaluations early on into the pandemic already showed that the pandemic was significantly impacting the mental and physical health of German children (Ravens-Sieberer et al., 2020), and later follow-ups of the study regularly confirmed these initial insights (e.g., Ravens-Sieberer et al., 2023).

School based education has been a key area impacted by the pandemic. While schools were reasonably quick to adapt to sudden changes in their teaching approaches during long periods of home-based learning here, too, we are seeing the consequences of the pandemic: children's learning progress has slowed. When children leave primary school, they now have less advanced skills, leaving secondary schools having to adapt to a changing cohort of students. As part of the ongoing Progress in International Reading Literacy Study, a recent publication

highlighted how German primary school students' skills in reading had declined from 2016 to 2021, with a deficit of up to one third of a school year (Ludewig et al., 2022). The authors attributed the most significant portion of the decline directly to the Covid-19 pandemic experiences. This seems more directly supported by other recent studies showing the same declines in other areas such as mathematics (Schult et al., 2022). These delays in learning are critical because not only do children have to catch up on skills and knowledge they should already have, they also have to continue acquiring new skills and knowledge.

There is thus clearly a problem that needs to be addressed early. However, school transition – moving from primary to secondary school – adds a further layer of difficulty to the existing problems. School transition is generally associated with student anxiety, which is by no means a new observation; students have to cope with environmental and social changes but also have to deal with educational changes such as new teachers, new demands, and new subjects (Tay & Hast, 2022). School transition remains an ongoing issue with high global consistency, and again with specific reference made to the Covid-19 pandemic that seems to exacerbate these experiences (Bagnall et al., 2020). This means, students who are ill prepared in core readiness skills for secondary schools are simultaneously having to cope with the already stressful experiences of school transition.

Most subject-specific anxiety research has typically focused on mathematics education. However, it is known that mathematics self-efficacy and anxiety have an impact on interest in science (Huang et al., 2019). At the same time, there is also recognition of a direct concept of science anxiety. It is already known that anxiety generally impedes participation in science classes, thereby directly affecting achievement and performance (Ucak & Say, 2019) and even more specifically knowledge acquisition (Theobald et al., 2022). However, the specific concept of science anxiety is less well explored despite having been formulated quite some time ago (cf. Mallow, 2006). Recently, an adapted rating scale for measuring science anxiety was developed (Megreya et al., 2021), only here establishing it as a distinct concept of anxiety from test anxiety and general anxiety. And since science relies on various skills that are now seen to be in critical delay – reading, working with numbers, comprehension – it is critical to prevent a knock-on effect that starts with unpreparedness at the end of primary school.

Focusing on science education is crucial. The most recent PISA evaluation (OECD, 2019) revealed German students are not particularly interested in science careers, and this may have become more exacerbated by the pandemic experiences. This may become a long-term problem for Germany since the student of today is the worker and active citizen of tomorrow, and as its future in Industry 4.0 is predicted to rely increasingly on a workforce that is science and technology literate (Hernandez-de-Menendez et al., 2020). By middle school age students have developed certain attitudes towards science in schools, and consequently also an interest or absence of such (see e.g., Moote et al., 2020). In addition, children, as indicated by the COPSY study (Ravens-Sieberer et al., 2020, 2023), are generally reporting greater anxiety levels, which are known to affect learning and engagement.

Theobald and colleagues (2022), in their study on anxiety, have suggested that training sessions designed to

improve study strategies can help students who are anxious about an exam, and this can also positively impact their knowledge acquisition. Future research, according to them, should focus on the development of interventions that facilitate effective knowledge acquisition to improve the educational prospects of highly anxious students.

Mindfulness is one particular strategy that has been gaining more attention in recent years. In mindfulness, individuals are attending to the present moment, becoming aware of it and accepting it. It includes five key exercises around breathing, concentration, bodily awareness, tension release and walking. Mindfulness has been successfully implemented in schools to alleviate stress by improving attention and emotion regulation (e.g., Lam & Seiden, 2020) – skills which children who are transitioning from primary to secondary school are still in the midst of mastering due to significant brain developments. Mindfulness has also been shown to be somewhat effective in positively supporting student anxiety in the particular context of school transition (Hutchinson et al., 2018). In the context of science education, however, mindfulness appears to have been limited to post-compulsory college level education (e.g., Calderón, 2017).

What, therefore, can be done to buck the observed trends at this point in time? By drawing together the different domains observed, and in light of the overall problem identified, the presently ongoing research seeks to address the following questions: 1) How significant is the issue of science anxiety amongst German 5th-graders following school transition, and 2) can science anxiety be improved through the implementation of a mindfulness programme?

Method

Sample

The sample currently consists of three classes of fifth-graders ($N = 67$) at a public regular school in the north of Germany who transitioned from primary to secondary school in the summer of 2023. In the German context, regular schools are to be distinguished from the academically more selective gymnasiums or from special schools, with regular schools being more inclusive and academically more heterogeneous in their student body that will typically cater for high and low academic performance as well (see e.g., Ditton et al., 2022). A regular school was thus selected for the evaluation as it allowed for a more meaningful evaluation of the nature of science anxiety in a broader group of ability levels. The three classes are approximately equal in student numbers and gender distribution.

Design and Procedure

The study, still in progress, is employing a quasi-experimental intervention format with a pretest-intervention-posttest design. Children in all three groups have to-date completed a translated form of the abbreviated science anxiety rating scale at the start of the school year. The results of this form the baseline measure.

Preliminary Results

To-date, only the pre-test has been conducted, which is to serve as a baseline measure. The results are shown in Table 1. Comparing the pre-test scores, a Kruskal-Wallis test shows that the three groups do not differ significantly in their mean scores, indicating that the occurrence of science anxiety is not greater in one group than in another. Although no qualifier is provided to evaluate the degree of science anxiety, as per the descriptors for the abbreviated science anxiety scale (Megreya et al., 2021) it is assumed that the average scores, which range from 2.54 to 2.66 across the three groups, indicate moderate anxiety.

Table 1. Mean pretest scores

	Group 1	Group 2	Group 3
All	2.66	2.54	2.57
Boys	2.25	2.38	2.09
Girls	3.11	2.72	2.93

Overall, girls ($M = 2.92$) reported significantly higher mean scores than boys ($M = 2.25$), $U = 347$, $p < .05$, $r = .33$. This observation is in agreement with some other studies showing similar gender effects in relation to science anxiety (cf. Megreya et al., 2021). However, no significant gender differences were notable within the individual groups, though for each group the mean scores were higher for girls than for boys.

Next Steps

Currently, each of the three participating classes has been allocated a different sequence of tasks. Groups 1 and 2 are currently receiving six weeks of mindfulness activity at the start of each science lesson. Group 3, acting as control group, is continuing their lessons in the usual approach. Teaching activities, materials and so on have not been amended in any way. Each lesson begins with the Silent 60 exercise. The students sit quietly for 60 seconds to prepare themselves for learning, focusing on a specific sound in the room, a provided image, or their breath. In the first week, it lasts 30 seconds, and the duration is then gradually extended to 60 seconds. This is then followed by a different mindfulness exercise lasting for around 3 to 4 minutes. The different exercises are shown in Figure 1.

After six weeks, children in all three groups will again complete the science anxiety rating scale. While Group 3 may possibly show some improvement in science anxiety levels due to having developed familiarity with the school subject, it is anticipated that any improvements will be more notable in Groups 1 and 2. To assess potential delayed effects of improvement, Group 1 will subsequently continue with the mindfulness activities for another six weeks, but not Group 2. At the end of the second six weeks, all three groups will again complete the abbreviated science anxiety rating scale. Continued improvement in Group 1 over Group 2 could indicate a

longer need for mindfulness implementation, whereas improvement in Group 2 might imply delayed improvements in form of an incubator effect.



Figure 1. Selection of mindfulness activities

Conclusion

From the preliminary results it is evident that science anxiety, as measured through the science anxiety rating scale, is present in German fifth-graders following school transition. Already ahead of time it is likely that regardless of intervention outcome different additional variables will be relevant to understanding the fuller picture of science anxiety in German classrooms that are not covered by this study but that give scope to further research. These include teaching styles, as these have not been standardized or amended across the three classes, factors linked to immigration and resulting higher efforts to include, such as the influx of students displaced through the Ukraine war which has resulted in greater classroom diversity, or separating science anxiety from how it is affected by transition related anxiety.

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